

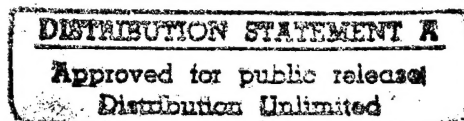
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**Chemical Weapons Convention
Verifiability Assessment**

Contract No. AC93MC1002

Prepared for

**U.S. ARMS CONTROL AND DISARMAMENT
AGENCY (ACDA)**



Prepared by

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EXECUTIVE SUMMARY

BACKGROUND

Entry-into-force of the Chemical Weapons Convention (CWC), anticipated for January 1995, will initiate a series of verification provisions, including inspections by international treaty organization staff. These inspections of industry and government facilities, in conjunction with declarations, other reporting, and consultation among state parties, have the aim of verifying the CWC.

A key element in the U.S. treaty ratification process is the assessment of the verifiability of the CWC through an analysis of the verification provisions in the body of the treaty and the implementing annexes. In addition to assessments by the Arms Control and Disarmament Agency (ACDA) and the intelligence community, a separate independent evaluation has been conducted by a group of recognized non-governmental CWC experts. This report provides the results of that assessment.

OBJECTIVE

The objective of this report is to assess the verifiability of the Chemical Weapons Convention in the context of:

- What kinds of violations might be carried out undetected.
- How easy or difficult is it to violate the CWC?
- What are the strengths and weaknesses of the CWC with regard to overall verification?

The verifiability assessment has been conducted based on two assumptions using selected scenarios. The first assumption is that the Preparatory Commission will develop sound verification procedures and verification will be effectively implemented by a highly qualified and trained international organization and inspection corps. Second, based upon U.S. intelligence sources and methods, at least photographic satellite information will be available to support verification.

The scenarios have been developed based on the CWC text and the premise that the objective of a violator country would be to maintain or establish an offensive chemical weapons capability. All the steps in the establishment of a chemical weapons offensive capability have been evaluated, with resulting scenarios that focus on the following activities:

- Chemical weapons storage sites
- Chemical weapons destruction sites
- Chemical production sites
- Allegations of use
- Law enforcement exceptions

CONCLUSIONS

- Reporting provisions of the CWC, including declarations, are sufficient for the collection of information for verification purposes.
- Routine inspection procedures are adequate for the verification of declarations and other reporting to a high degree. Routine inspection procedures are not designed to detect a violator determined to circumvent the CWC, but may provide a means to identify potential indicators of cheating.
- Challenge inspection provisions may provide a means of identifying probable non-compliance, but restrictions on facility access and sampling and analysis limit the potential degree of verification.
- Opportunities for sampling and analysis under the CWC inspection provisions and the efficacy of the methods and laboratories that support sampling and analysis are critical factors in enhancing the degree of treaty verifiability prior to entry-into-force and in the long term.
- Determination of treaty non-compliance in the production of chemical weapon agents and, more particularly, scheduled precursors can be extremely difficult. However, requirements for establishing an offensive chemical weapons capability are considerably expanded beyond production to include agent storage, munition fill and close, and stockpiling munitions as well as related safety and security measures and equipment. Each step in the full cycle of creating an offensive capability presents another opportunity to identify indicators of a violation and poses a risk to the violator.
- Difficulty in discriminating between permitted and prohibited activities under the CWC complicates verifiability. Improved U.S. intelligence collection means and methods for identifying indicators of potential non-compliance would enhance verification and contribute to deterrence of violations.
- Fundamental to achieving the verification aims of the CWC is a highly qualified and well trained corps of treaty organization inspectors.
- Technology to improve the verifiability of the CWC must continue to evolve into the future. A strong U.S. research and development program will contribute to enhanced verification by providing the Organization for the Prohibition of Chemical Weapons with better equipment, methods and techniques to conduct inspections, assess compliance, and verify the Chemical Weapons Convention.

CHEMICAL WEAPONS CONVENTION VERIFIABILITY ASSESSMENT

BACKGROUND

The signing of the Chemical Weapons Convention (CWC) by over 150 nations presents the world community with the most ambitious and far reaching arms limitation treaty in history. The CWC is unique among arms control agreements not only because it eliminates an entire type of weapon and warfare but also because of provisions that permit international inspections on a routine or challenge basis of thousands of chemical, pharmaceutical and related industry facilities. This treaty, with the broadest on-site inspection rights in history, will enter-into-force 180 days after the date when 65 nations deposit ratification at the Hague, but not before January 13, 1995.

Ratification of the CWC by the United States and other nations will represent achievement of a long sought goal, prohibiting the development, production, stockpiling and use of chemical weapons. However, along with achievement of this goal come international inspection provisions which permit measured intrusion into private U.S. industry and sensitive government facilities. Throughout CWC negotiations and now at the deliberations of the Preparatory Commission prior to entry-into-force, the United States has attempted to balance three concerns in the furtherance of the country's interests. These concerns are: (i) the verifiability and deterrent effectiveness of the CWC; (ii) protection of sensitive information; and (iii) the cost of implementation.

Preparation for U.S. ratification of the CWC includes the key element of an estimate of the degree to which the Convention is verifiable. In that regard two reports have been prepared by the U.S. Government, one by the Arms Control and Disarmament Agency and the other by the intelligence community, to assess verifiability of the treaty. A separate evaluation by a group of recognized Chemical Weapons Convention experts was also conducted in order to provide an independent assessment of treaty verifiability. The purpose of this report is to provide the results of that independent assessment.

OBJECTIVE

The objective of the report is to determine the degree of verifiability of the CWC through a broad-based evaluation of the strengths and weaknesses of the verification provisions in the treaty.

In achieving this objective the report addresses verifiability within the context of

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- What kinds of violations might be carried out undetected
- How easy or difficult is it to carry out each violation
- What are the strengths and weaknesses of the CWC with regard to overall verification

From these evaluations the limits of current CWC language and procedures have been assessed. The resulting assessment identifies procedural or other recommendations that do not change the language of CWC Articles or Appendices, but do influence implementation.

The verifiability assessment has been developed from a series of scenarios that address military and civilian verification situations, derived from the prohibited and permitted activities under the CWC provisions. From these scenarios specific opportunities for countries to violate the CWC have been identified. These opportunities could lead to violations of specific provisions of the CWC for scheduled chemicals (i.e., stockpiling of chemical weapons) and as violations involving non-scheduled chemicals.

The analysis has been conducted from two perspectives using selected scenarios. First, each scenario has been evaluated in the context of the application of the CWC's verification provisions alone. One key assumption in this set of analyses is that the Preparatory Commission's efforts at defining and developing detailed procedures for verification will result in sound implementation provisions. Another principal assumption is that verification also will be implemented effectively, with organizational resources, including inspectors, that are adequately skilled for the task of verification.

The second perspective within which the overall analysis has been performed is the consideration of information derived from intelligence sources that the United States might have access to. These assessments assume the availability of photographic satellite intelligence. Other forms of intelligence that might provide relevant information are assumed problematic and are case dependent. Various ways in which the U.S. could support verification with this information and its impact on verification outcomes have been assessed.

SCENARIOS

Scenarios for the assessment of the degree of verifiability of the treaty have been developed based on the CWC text. A critical point in the consideration of scenarios is that the objective of the violating country is to maintain or establish an

offensive chemical weapons capability. The scenarios address activities that are clearly violations of the CWC as well as activities in which the country is exploiting loopholes in the CWC provisions.

A final consideration in scenario development and the verifiability assessment is that an outcome of an operational weapon must be intended. This factor involves evaluation of the steps in the full cycle to achieve operational chemical weapons. These steps include development, production and stockpiling, with the associated times and activities.

Scenarios have been developed for the following activities described in the CWC Articles and in the Verification Annex.

- Chemical weapons storage sites
- Chemical production sites
- Chemical weapons destruction sites
- Allegations of use
- Law enforcement exceptions

1. **Chemical Weapons Storage Sites**

a. **Undeclared Chemical Weapons Storage Facilities**

- **Scenario.** A party to the Convention may elect to maintain an offensive chemical weapons capability by failing to declare one or more chemical weapons storage facilities or by not declaring any of its sites.

- **Violation.** A party to the Convention fails to declare a mandated treaty facility and maintains a chemical weapons stockpile.

- **Strengths and Weaknesses of Provisions.** The international organization implementing the treaty, the Organization for the Prohibition of Chemical Weapons (OPCW), would not have the means to locate any undeclared chemical weapons storage facility. The provisions of the CWC Verification Annex provide no mechanism other than a challenge inspection or procedures for consultation and fact-finding (Article IX) to make a determination of the failure of a state party to declare chemical weapons stockpile facilities.

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Intelligence sources currently do not have the capabilities to provide information that would identify a chemical weapons storage facility as photographic data are likely to be inconclusive. In the case where information available from intelligence sources is sufficiently strong to support a challenge inspection request, the challenged party will, if guilty, likely deny or carefully manage and limit access. The result could be inconclusive. However, procedural mechanisms, such as the inspection report's indication of inspected party degree of cooperation, and the fact that denial of access is itself a violation of the CWC, might significantly assist in the assessment of the challenged party's program.

- Conclusion. There are no reliable ways to deter a state party from failing to declare and subsequently to detect and confirm that a state party is maintaining an undeclared stockpile. The possibility of a challenge inspection may, however, have a deterrent effect.

- Recommendations.

- Improved intelligence means to detect undeclared stockpiles should be sought.

b. Undeclared Chemical Weapon Stocks

- Scenario. A party to the Convention may elect not to declare all its CW stocks. In this scenario the state party declares its chemical weapons stocks, under-declaring the total number of munitions. The undeclared munitions would be stored at the declared location, but intermixed with stockpiled conventional munitions.

- Violation. A party to the treaty maintains an undeclared stockpile of chemical weapons munitions.

- Strengths and Weaknesses of Provisions. The declaration and verification provisions using routine inspections for chemical weapons stockpiles do provide the OPCW inspectors an opportunity for determining whether or not stocks at a declared site have been in fact fully declared. The use of non-destructive evaluation (NDE) equipment by inspectors in routine inspections offers a way of differentiating between chemical munitions and conventional munitions in mixed stockpile situations or in confirming chemical weapons declarations themselves.

Since the facilities are declared, intelligence sources such as satellite photography do not offer information that would contribute to the detection of the

under-declaration of the number of chemical munitions. Should a basis for a challenge inspection request arise, such as through a routine inspection, the use of NDE techniques could provide a way to identify chemical munitions.

- Conclusion. The ability to differentiate between chemical and conventional munitions using NDE and related procedures may serve as a deterrent to not declaring all chemical weapons in a mixed munition stockpile at a declared site.

- Recommendations.

- Non-destructive evaluation equipment should be considered for incorporation into routine and challenge inspection procedures for chemical weapons stockpiles as a means to non-intrusively sample declared stocks at a statistically significant level.

- Develop improved non-destructive evaluation equipment and application techniques to enhance NDE's practical field application and increase its credibility as an inspection tool.

2. Chemical Production Sites

a. Undeclared Chemical Weapon Agent Production Facilities

- Scenario. The decision not to declare one or more Schedule 1 production facilities by a party to the Convention is an option for acquiring a chemical weapons offensive capability. The basis for this scenario is that the state party intentionally fails to declare one or more stand-alone or embedded Schedule 1 production facilities. Under this scenario the facility must either have an associated weapon fill and close operation and on-site storage for the agent or a means to transport the Schedule 1 agent to a storage facility off-site. The weaponization of produced agent at the production site expands the site's size and, therefore, its potential for becoming a target for increased observation. Weaponization elsewhere requires transport of the agent.

- Violation. The failure to declare all required Schedule 1 production facilities (those facilities that produce more than 100 grams of Schedule 1 annually) and the operation of an undeclared Schedule 1 production facility are both violations of the CWC.

- Strengths and Weaknesses of Provisions. Declarations and initial inspections will not significantly contribute to the detection of the undeclared chemical weapons stand-alone production facility violation. Neither do provisions for routine inspections offer a reliable means of identifying this type violation at an embedded CW production plant since the facility agreement may preclude access to areas where the violation actually occurred.

It is unlikely that photographic or other satellite intelligence sources will provide definitive information that indicates chemical weapons (Schedule 1) production because of the lack of discrete indicators for that type facility. Observation of site activities over time might provide indicators, particularly if weaponization is undertaken at the production site.

Should sufficient evidence become available to warrant a challenge inspection, the initiation of a challenge inspection would probably result in denial of access to the facility or to an illegally embedded part of the facility. Such denial of access would itself be a violation of the CWC.

An alternative to the scenario is that the state party allows access, but has decontaminated the facility and contends that any agent traces discovered are the result of pre-1946 production. (This explanation eliminates the excuse for all nerve agents since production is post-1946.) Reliable technology is not available for time dating trace samples, a technique which would be helpful in establishing the age of chemical weapons agents.

- Conclusions. Given the lack of discrete signatures of a Schedule 1 production facility, except using detailed on-site sampling and analysis, it is unlikely that intelligence means would identify a clandestine chemical weapons production facility. If a suspect facility is nevertheless found, a challenge inspection and related provisions for sampling and analysis could result in a high probability of detection of the violation, if sufficient access is gained. The challenging state party could minimize the inspected state party's ability to restrict access by focusing the requested perimeter as narrowly as possible.

- Recommendations.

- Improve intelligence methods, such as overhead detection and discrimination capabilities, directed at detection of chemical weapons production indicators, including those at embedded production facilities.

- Provide OPCW inspectors with an adequate level of knowledge and training to detect indicators of illicit production at an embedded production facility.

b. Declared Chemical Weapons Production Facility

- Scenario. Continuation of production at - or restart of - a declared chemical weapons production facility by a state party is attempted after CWC entry into force.

- Violation. A state party production of Schedule 1 at a facility that has been declared as shut-down.

- Strengths and Weaknesses of Provisions. Current procedures in the Verification Annex of the Convention provide an adequate framework for deterring and, alternatively, identifying this kind of violation. However, procedures must be operationalized through detailed instructions on surveillance, monitoring, and security to preclude restart of either a stand-alone or embedded Schedule 1 facility. Photographic or other intelligence may be able to provide information regarding the continued operation or restart of this type facility. In particular, observation of site activities over time by overhead intelligence capabilities may provide indicators of continued production.

- Conclusion. Provisions for verification are adequate to deter and detect continued operation or restart of a declared Schedule 1 production facility.

- Recommendations.

- Identify overhead detection and discrimination capabilities that would provide direct and indirect indicators of production at a declared closed chemical weapons production facility, including embedded production facilities. Define and pursue improvements in capabilities necessary to provide indicators.

- Emphasize the need to implement existing treaty Verification Annex provisions for surveillance, monitoring and security to the point that production is deterred or the probability of being detected is unacceptability high.

c. Declared Single Small Scale Chemical Weapons Agent Production Facility

- Scenario. The Convention permits the state parties to produce Schedule 1 for research, medical, pharmaceutical or protection purposes. Each state party is permitted one single small scale facility for production of up to one aggregate tonne of Schedule 1 chemicals per year. A second facility for production of Schedule 1 chemicals in aggregate quantities not exceeding 10 kg per year for protective purposes is allowed. In addition, other facilities may produce Schedule 1 chemicals for permitted purposes in quantities of more than 100 g per year, but the aggregate quantity cannot exceed 10 kg per year per facility.

A scenario for developing a chemical weapons offensive capability is to extend production of the single small scale facility beyond the permitted one tonne per year. Given the maximum allowable configuration of 500 liters aggregate in reaction vessels with no single reaction vessel over 100 liters, production of one batch a work day for the 260 work days in a year could result in as much as 130 tonnes of agent(s) in a year. This amount represents a militarily significant quantity (100 tonnes is generally considered a militarily significant quantity) for conflicts in the contemporary world, i.e., regional or Third World nation. As an illustration of the potential impact of a militarily significant quantity, 400 to 500 rounds of artillery sized munitions with chemical agent fill is sufficient to cover an area of 500 meters by 500 meters with a lethal dosage. This is equivalent to a small town. The agent-fill for these munitions equals 3 days of single batch production.

- Violations. Two violations are related to this scenario: production exceeding the allowable one tonne level; and, stockpiling of chemical weapon agents in militarily significant quantities.

- Strengths and Weaknesses of Provisions. The declaration, annual reporting and routine inspection provisions of the Verification Annex and the prohibition of a continuous process operation configuration provide a basis for deterrence and detection of violation. The fact that the OPCW will routinely inspect the facility and on-site monitoring instruments are permitted, offers a means of enhancing verifiability. There would be no reason to challenge such a facility as full access is mandated for routine inspections. It is unlikely that available intelligence sources will provide additional information that indicates production beyond one tonne a year.

- Conclusion. Although illicit production is theoretically possible at a declared single small scale facility, the quantities involved and the access permitted OPCW inspectors and related provisions could serve to deter significant violations.

- Recommendations.

- Ensure that provisions for monitoring and inspecting declared single small scale production facilities are fully implemented, to include instrumentation.

- Identify overhead capabilities that might provide indicators of excessive production at a level that would be considered militarily significant, such as traffic and storage of large quantities of chemicals at a single small scale production facility.

- d. Undeclared Small Scale Chemical Weapons Production Facility (One or More)

- Scenario. A state party could elect to produce Schedule 1 chemicals in one or more small scale production facilities equivalent in capacity to the permitted single small scale production facility. The capacity of each small scale facility with reaction vessels that individually do not exceed 100 liters and in aggregate 500 liters would have a capacity of approximately 130 tonnes per year based on one batch per day for each of 260 work days.

Each small facility could be located within a military compound or industrial complex that is not subject to routine inspection under CWC provisions. A building of less than 2, 500 square feet would be adequate to house all elements of the production facility.

- Violation. Prohibited production and stockpiling of chemical weapons agents in militarily significant quantities by a state party.

- Strengths and Weaknesses of Provisions. There are no routine verification provisions that provide the basis for deterring or detecting a violation at a chemical weapons capable small scale production facility. The undeclared facility cited in this scenario offers a means for a small country to develop an offensive chemical weapons capability. This type of facility is under the size limit for declaration and annual reporting as either a Schedule 2, a Schedule 3 or "Other Chemical Production Facility." Furthermore, the relatively small size of this type of unit makes it easy to dismantle and at least partially decontaminate the site.

Intelligence sources are unlikely to provide information that would identify illicit chemical weapons agent production at a small scale facility. However, opportunities for detection of a violation using intelligence information to support an OPCW challenge

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inspection are increased by the number of activities and the length of production necessary to accomplish an offensive chemical weapons capability. The challenge inspection procedures should be adequate to determine a violation or elicit suspicious denial of access. The ability to perform sampling and analysis under challenge inspection provisions offers one means of obtaining evidence of a violation.

In addressing this scenario the factor of full cycle chemical weapons production, including weaponization and transport, must be borne in mind. The step of producing a chemical weapons agent does not in itself result in an offensive capability. Munitions must be filled and stored, requiring additional activities that might provide indicators of a violation.

The importance of this chemical weapons production scenario is that the plant size, as defined by its output, is below the specified production threshold required for declaration of the facility. The result is that this type of facility is neither declared nor subject to routine verification inspections under the CWC provisions.

- Conclusion. The undeclared chemical weapons agent (Schedule 1) small scale production facility or a series of such sized production facilities offers an opportunity for a country to produce agent for an offensive chemical weapons capability.

- Recommendations.

- Indicators of undeclared small chemical weapons agent production facilities should be defined by the intelligence community.

- Intelligence methods should be tailored or improved to provide indicators of prohibited chemical weapons agent production at a declared small scale facility.

- e. Declared Commercial Chemical Plant Producing Schedule 2/Schedule 3 in Excess of Declaration

- Scenario. A state party elects to produce precursors on Schedule 2 and Schedule 3 at one or more declared plants beyond the amounts reported to the CWC. The precursors are subsequently stockpiled for future use in the production of CW agents.

- Violation. The violation is production of a scheduled chemical(s) in excess of declared and reported quantities or a violation by virtue of possessing undeclared stockpiles.

- Strengths and Weaknesses. The provisions of the Verification Annex are inadequate to identify a violation of over-production. While routine inspection provisions include record reviews and production line inspection, the fact that the chemical(s) are commonly produced and declared will make deterrence and detection difficult. Further, the inspection aim of the CWC for a declared commercial plant is to verify the declaration of the plant site and that Schedule 1 chemicals are not being clandestinely produced. Even with intelligence information that might be used by a state party to initiate a challenge inspection, it is unlikely excess (unreported) production would be discovered. While discovery of excessive quantities may serve as an indicator of other non-compliant activities, the presence of undeclared stockpiled precursors alone is not necessarily a violation of the CWC. However, if an inspection finds that quantities are excessive and are not justified by the state party, such quantities could be judged by the OPCW as a violation. It is unlikely that intelligence sources would provide information that would contribute to the detection of this type violation.

- Conclusion. There are no practical ways to detect the production of precursors beyond declared or reported limits.

- Recommendations.

- Methods for assessing plant production data, including flow of chemicals from feedstock, to shipped or consumed product, should be developed.

- Inspector training should include techniques for determining, at least qualitatively, the total stockpile of produced Scheduled chemicals.

f. Declared Commercial Chemical Plant Producing Undeclared Schedule 2 Chemicals

- Scenario. A state party could decide to produce undeclared Schedule 2 precursors at a declared plant site. In this scenario the state party would stockpile the precursor(s) either at the plant in an undeclared plant site area or ship them to another facility not subject to routine CWC inspection.

- Violation. A state party undertakes the production of undeclared Schedule 2 chemicals, which results in a further violation of possession of undeclared Schedule 2 stockpile.

- Strengths and Weaknesses of Provisions. The provisions of the Verification Annex are inadequate to detect a violation of this type with a routine inspection as the verification aim is to confirm the declaration and subsequent annual reports. While intelligence methods do not readily lend themselves to development of information on chemical plant production, if a challenge inspection is conducted then related sampling and analysis provisions might be used to detect undeclared precursor production. But a range of explanations, from previous production to a state party admitting it failed to declare a chemical through an administrative error, could serve to explain a violation. The state party might also deny or manage access on confidentiality grounds, resulting in a limitation on the ability to acquire conclusive data.

- Conclusion. Similar to the situation of excessive production of Schedule 2/3 chemicals described above, the production of undeclared Schedule 2 is not likely to be significantly deterred or unambiguously detected by routine or challenge inspection within the provisions of the Verification Annex. Even the discovery of an undeclared precursor stockpile could be inconclusive for a finding of a violation.

- Recommendations.
 - Inspector training should include techniques for identifying indicators of unreported production.
 - Methods and procedures for assessing plant production data, at least qualitatively, including flow of chemicals from feedstock to shipped or consumed product, should be developed.

g. Schedule 2 Production at Undeclared Commercial Plant Site

- Scenario. A state party elects to produce precursors (Schedule 2) above the allowed threshold at an undeclared plant site. These precursors will be stored on-site until the decision to produce chemical weapon munitions is made. At that point the precursors will be made into agents at the plant site or shipped to another plant site for production, munition fill and close and storage.

- Violation. Production of unreported Schedule 2 precursors and the stockpiling of precursors for chemical weapons production by a state party.

- Strengths and Weaknesses of Provisions. Provisions for routine inspections are inadequate to deter or detect this scenario. The failure to

declare the site as either a Schedule 2 producer or as an Other Chemical Production Facility removes it from consideration for inspection and reports review.

While intelligence information may provide a basis for a challenge of the plant and plant site, it is unlikely production itself would be found by an inspection. Rather, the challenge inspection, using sampling and analysis in various facility locations, could probably provide indicators of a possible violation. However, the ability to sample appropriate places is dependent on the limit imposed by managed access and concerns for confidentiality.

- Conclusion. The greatest difficulty in detecting a violation of this type is simply identifying the plant at which the activity is being conducted. Although a plant may be identified and challenged, being able to conclusively establish a violation appears unlikely because of both managed access and plausible explanations. A "smoking gun" would probably not be available, unless appropriate samples for chemical analysis could be obtained. Even then, without a reliable means of estimating production capacity, the inspected state party can claim production is below the CWC reporting threshold.

- Recommendation.
 - Ensure challenge inspection sampling and analysis procedures are sufficiently defined to permit the detection of Schedule 2 chemicals at a commercial facility not previously declared for production of Schedule 2. Such defined procedures might include the right to test for specific chemical bonds that would be suggestive of a violation while not being excessively intrusive.

h. Production of Non-Scheduled Chemicals with Chemical Weapons Utility at an Undeclared Plant Site

- Scenario. A state party produces a compound that is not a CWC listed chemical agent or precursor, but has a toxicity that approaches or exceeds nerve agent GB or VX and other properties suited for use as a chemical weapon. In order to remain within the threshold of "other chemicals," the state party limits production to less than 200 tonnes. The subsequent use of this chemical to create a chemical weapon offensive capability will require weaponization and storage. However, since the chemical falls outside the CWC schedules, storage of the chemical itself before weaponization does not have to be concealed as long as its production can be justified for purposes not prohibited by the CWC.

- Violation. No violation exists under the current CWC provisions unless the intent to use the produced chemical for prohibited purposes is

demonstrated or adequate justification does not exist for commercial or other non-chemical weapons use.

- Strengths and Weaknesses of Provisions. Since the chemical selected for production is neither a scheduled nor a PSF compound, it is in itself not a declarable chemical under the CWC. With the production of less than 200 tonnes the plant site itself is not subject to inspection under the CWC provisions of "other chemical production facilities." Current procedures do not facilitate the reporting of what may in fact be a significant violation.

Should intelligence provide a reason to challenge this facility, the challenged state party would probably acquiesce. The state party would, however, likely exercise its rights under challenge inspection to deny or to restrict sample analysis to the presence or absence of chemicals listed in Schedules 1, 2 and 3 or appropriate degradation products. The compound will not be identified as a CWC scheduled chemical since it is not on any schedule. However, while presently permitted procedures can not be counted on to identify the nature of the chemical subjected to sample analysis, procedures could be instituted that would suggest that a chemical of concern is present. The presence of such a compound under suspicious circumstances that are not adequately justified by the inspected state party could be reported to the OPCW for further consideration and clarification.

- Conclusions. The above scenario illustrates two "problem" areas in the CWC. First, to accommodate an overabundance of facilities caught by an overly loose definition of chemical plants, the minimum reporting and production limits have been set well above what constitutes a militarily significant amount of agent, removing potentially dangerous sites from the possibility of routine surveillance and its deterrent effect. Second, in an effort to protect confidentiality, chemical analysis in a challenge situation may be restricted by the challenged state, precluding analysis of either current or newly created highly toxic chemical materials.

- Recommendations.

- The Preparatory Commission should be asked to get agreement from participating state parties that samples obtained during challenge inspections can be analyzed for specific combinations of chemical elements associated with highly toxic chemicals. The presence of chemicals with such combinations could be indicative of the production or stockpiling of precursors or agents not now on the list of scheduled chemicals that would nevertheless be of concern.

- Highly toxic non-scheduled chemicals potentially suitable for use as chemical weapons should be identified and screening techniques developed.

- Given the large number of potential chemicals involved, options for addressing the inclusion of highly toxic non-scheduled chemicals suitable for chemical weapon purposes within the CWC should be determined and assessed.

3. Chemical Weapons Destruction Sites

- Scenario. A state party elects to divert agent at a declared chemical weapons destruction site in order to create an offensive chemical weapons capability. Under this scenario the state party has provided the basis for other states to believe that all agent and munitions have been destroyed.

- Violation. The failure of a state party to destroy declared chemical weapons and the establishment of an undeclared stockpile.

- Strengths and Weaknesses of Provisions. The provisions of the CWC and the Verification Annex are adequate for deterring and detecting diversion of agent or munitions. The combination of provisions for permanent OPCW inspectors at the destruction site, process monitoring, on-site sampling and laboratory analysis, and security and surveillance of the stockpile prior to destruction offer a sound basis for verification of destruction.

One weakness is that bulk chemical weapon agents in large quantities (tonne to twenty tonne containers) are susceptible to diversion by the replacement of a portion of the agent with appropriate non-agent chemicals. While provisions for sampling and analysis offer a means to detect diversion, procedures currently in the Verification Annex are not adequate to establish the baseline characteristics of bulk agents across a state party's stockpile. Procedures for sealing bulk agent containers, where possible, and baseline sampling of bulk agent would both strengthen detection of diversions and serve as a deterrent.

- Conclusion. Diversion of agent or munitions at a destruction site is impractical if available provisions are fully implemented.

- Recommendations.

- A closer examination of procedures for inspecting and destroying bulk chemical agent containers is necessary to ensure that the

contents of bulk containers are and remain what has been declared. Procedures for agent stockpile monitoring developed by the Preparatory Commission should include statistically significant baseline and interval sampling of bulk stocks.

- Provisions for surveillance, monitoring and inspection at chemical weapon destruction sites should be implemented to the extent that a high probability of deterrence or detection of a violation is achieved.

4. **Allegation of Use**

- **Scenario.** A state party makes an allegation of the use of chemical weapons or riot control agents as a method of warfare. This is presented to the OPCW as a request for an investigation of an alleged use of chemical weapons. Two potential situations are likely to surround the allegation: (i) the requesting state party has been attacked with chemical weapons; and, (ii) the requesting state party alleges the use of chemical weapons in the territory under the control of a second state party. In both cases there are casualties, including fatalities.

- **Violation.** The use of chemical weapons for warfare by a state party.

- **Strength and Weaknesses of Provisions.** The provisions of the CWC are adequate in terms of ability to investigate the allegation of use. In the instance of an attack against the state party requesting the investigation, access is likely to be available. However, for the case of territory under the control of a second party access could be denied or managed to limit the investigation.

With regard to verification of the allegation there are several technical considerations. Samples must be timely with an associated standard of quality for sampling and analysis that maintains the credibility of the evidence of use. The procedures adopted for implementation should include sampling and analysis of the widest range media (vegetation, soil, materials, animals, humans, etc.). In addition, a baseline of Scheduled chemicals (agents, precursors and degradation products) for all participating state parties should be established to support assessments of allegation of use. Intelligence sources could be used to support verification of alleged use.

- **Conclusion.** The CWC provisions for investigation of allegation of use are defined adequately to accomplish verification, if implementing procedures, including sampling and analysis, are applied in a timely fashion to provide the technical foundation for unambiguous findings.

- Recommendations.

- Samples from all participating state parties' stockpile of chemical weapons should be archived by the OPCW.

- A U.S. program should be established that will provide the OPCW with the methods and data to assure high quality analytical capabilities are available for alleged use situations.

5. Law Enforcement Exception

- Scenario. Under the guise of the need to be prepared to deal with domestic unrest, a state party acquires a significant quantity of lethal and non-lethal chemical agents. Included are grenades and bulk agents for dispensing which have been stockpiled ostensibly by the state party's law enforcement agencies in types and quantities consistent with purposes not prohibited by the CWC.

- Violation. There is no apparent violation. Should the state party intend to use the stockpile as a method of warfare, then a violation would occur.

- Strengths and Weaknesses of Provisions. One of the purposes for the use of chemical agents not prohibited by the CWC is "law enforcement including domestic riot control." Riot control agents are defined in the CWC as "any chemical not listed in a Schedule which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following exposure."

The CWC has no definition, however, of chemicals permitted for law enforcement. This lack of definition creates a loophole whereby a state party could produce highly deleterious or lethal chemical weapons for prohibited purposes, but claim they are intended for law enforcement. Such an assertion could be difficult to refute, although the type of agent and method of delivery would provide indicators of intent. For example, it is difficult to justify artillery shells or mortar rounds for law enforcement purposes.

There are no routine inspection provisions that apply to this situation. A challenge inspection might result in the detection of some of the stockpile, but it is unlikely that the entire stockpile would be found as such munitions are usually widely dispersed. Managed access and even partial or complete denial of access could also interfere with or prevent detection of stockpiles that would be suspicious under the CWC.

- Conclusions. The use of a law enforcement exception as a means to justify stockpiling chemical weapons for military purposes would constitute a violation of the CWC. However, the need to demonstrate intent and the inability of the OPCW to do so could impact on the effectiveness and credibility of the CWC.

- Recommendation.

- After entry-into-force the CWC Executive Council should consider further definition of chemicals permitted for law enforcement use, without requiring that such chemicals be declared.

RECOMMENDATIONS

There are a number of recommendations that will enhance the CWC provisions and related verification while offering the additional benefit of improving deterrence. These recommendations are presented in terms of the purpose served and the action required by the United States during the Preparatory Commission implementation activities or upon entry-into-force.

(1) In order to ensure that the verification aims of the CWC are being implemented most effectively and provide enhanced deterrence of violations, the United States should support the OPCW inspector training program to the maximum extent necessary to achieve an inspector cadre that is professional by education, background, and training, knowledgeable in the CWC, and well versed in the technical aspects of chemical weapons.

(2) In order to improve intelligence collection to identify potential CWC violations and contribute to deterrence of violations, the United States should pursue enhanced methods of overhead detection and discrimination.

(3) In order to technically support enhanced CWC verifiability, the United States should establish and maintain a strong research and development program and provide results to the OPCW through an effective technical assistance program.

(4) In order to ensure the credibility (quality) of laboratory analysis require annual certification of each designated laboratory used by the OPCW.

(5) In order to ensure sufficient designated laboratories are available for analysis of treaty inspection samples, at least two laboratories for each potential analysis should be certified in each treaty-defined region.

(6) In order to technically support CWC sampling and analysis provisions, the United States should establish a vigorous U.S. program to assure high quality analytical capabilities. In particular, development of methods for time-dating samples of chemical weapon agents and degradation products should be pursued.

(7) In order to have a baseline for use in the analysis of chemical weapon agents in various verification activities, samples from all declared stocks (munitions and bulk) should be collected and an archive established under the OPCW. Major degradation products of these chemical agents should be archived where feasible.

(8) In order to positively identify the content of munitions in a non-intrusive way, the United States should continue to pursue methods of non-destructive evaluation for prohibited chemical weapon munitions.

(9) In order to strengthen the credibility of challenge inspection results, the U.S. should seek the understanding within the Preparatory Commission and subsequently within the OPCW that a challenging state party may request that at least one laboratory involved in analysis of samples relating to the challenge be selected from among laboratories in the treaty-defined region of the challenging state party.

(10) In order to provide in a challenge inspection a means of identifying the presence of non-scheduled chemicals that might possibly be considered a chemical weapons agent, the United States should seek modification to--or an interpretation of--the Annex 2, Part X challenge inspection procedures to permit screening for such chemicals and subsequent specific analysis.

(11) In order to provide the challenging state party with sufficient information to assess for potential violations, the U.S. should seek agreement from the OPCW that the content of challenge inspection reports to states parties should seek to maximize, subject to agreed safeguards, the amount and quality of information of use to the challenging state in resolving its concern.

(12) In order to ensure that a loophole is not created by a state party in interpreting use permitted for law enforcement, the United States should seek clarification of agents permitted for law enforcement, restricting such agents to those that satisfy the CWC definition of riot control agents.

APPENDIX A

**INDEPENDENT VERIFIABILITY ASSESSMENT PANEL
BIOGRAPHICAL SKETCHES**

William C. Dee.* Mr. Dee is one of the world's foremost authorities on technology involved in the development, production and employment of chemical weapons. During his 35 year career with the Department of the Army, he has served in positions that have touched on all aspects of chemical weapons. In his recent role as Assistant to the Commander of the U.S. Army Chemical and Biological Defense Command, Mr. Dee has served as a technical advisor to not only the Department of Defense chemical and biological weapons treaties research and development programs, but to the U.S. Arms Control and Disarmament Agency and the United Nations. He served both as one of the initial UN inspectors of Iraqi chemical weapons installations and as a member of U.S. teams evaluating chemical weapons production and destruction facilities of the former Soviet Union. Mr. Dee served as Director of Munitions and the Binary Program Project Manager (1981 to 1991). As a project engineer during the 1960's he is credited with the effort that resulted in the creation and development of binary chemical munitions as well as significant roles in the development systems for riot control and incapacitating agents.

Dr. Fred Elmer. Dr. Elmer has worked on arms control treaty verification, implementation and compliance issues for more than twenty years. For over a decade he was Assistant Director of ACDA and Chief of the Bureau of Verification and Intelligence. In that role he was a leading participant in matters relating to strengthening U.S. capability to verify a Chemical Weapons Convention and in developing options that would maximize verifiability in light of competing pressures. Prior to his tour at ACDA, Dr. Elmer held senior positions in the Department of Defense, industry and NASA's Jet Propulsion Laboratory. In all of these assignments the evaluation and development of systems, devices and sensors for the acquisition of data was a major element.

R. William Mengel. Mr. Mengel has over twenty years experience in the technical and policy aspects of chemical, biological, nuclear and conventional arms control and arms transfers. Since 1985 he has been continuously involved in a wide range of projects for Department of Defense and the Arms Control and Disarmament Agency in support of the Chemical Weapons Convention negotiations, Preparatory Commission's expert working groups, U.S. preparations for implementation, and Russian-U.S. agreements on chemical weapons. He has participated in several trial inspections and

* While the composition of the panel is described as non-governmental experts, Mr. Dee, a U.S. Department of Army civilian employee, was included because he is unique in his experience and knowledge of chemical weapons research, development, engineering and production.

contributed to a number of technical papers for Department of Defense. The founder and a principal technical contributor to EAI Corporation since 1980, Mr. Mengel's background includes chemical and biological defense, chemical weapons destruction, environmental remediation of previous chemical weapons sites, and chemical, biological and nuclear terrorism as well as related arms control.

Dr. Matthew Meselson. Dr. Matthew Meselson is the Thomas Dudley Cabot Professor of Natural Sciences in the Department of Biochemistry and Molecular Biology at Harvard University. He was graduated with a Bachelor of Philosophy degree from the University of Chicago and a Doctorate in physical chemistry from the California Institute of Technology. Dr. Meselson is the recipient of numerous awards for distinguished accomplishment in science, including the National Academy of Sciences Prize for Molecular Biology; the Eli Lilly Award in Microbiology; the Scientific Freedom and Responsibility Award of the American Association for the Advancement of Science; and honorary doctorates from the University of Chicago, Yale, and Princeton. He is a member of the National Academy of Sciences, the Institute of Medicine, the Royal Society, and the Academie des Sciences. In addition to his research in biochemistry and molecular biology, Dr. Meselson for 30 years has had an interest in chemical and biological weapons and arms control and has served as a consultant on this subject to various government agencies, including the National Academy of Sciences on chemical weapons demilitarization and alternative technologies.

R. Nicholas Palarino. Mr. Palarino is currently Director of Policy, Security, and Technology Analysis Directorate at Pacific-Sierra Research Corporation (PSR). He supervises a staff that provides expertise to the government in arms control implementation, technology transfer, and counterproliferation issues. His specific expertise focuses on the analysis of a wide spectrum of security and arms control matters, their associated verification regimes, and their implications for national security. Prior to working at PSR, Mr. Palarino was the Deputy Special Advisor to the President and Secretary of State for Arms Control Matters. He participated in US-USSR Summit and Ministerial meetings and conducted consultative visits to Tokyo, Beijing, Seoul, and other foreign capitals explaining and promoting US arms control policy. He engaged in discussions with representatives of the Soviet Union during INF negotiations and the third 5-year Review of the Antiballistic Missile Treaty. As a policy planner, Mr. Palarino briefed representatives of the North Atlantic Council on the Nuclear and Space Talks and participated in discussions with foreign representatives of the 35-nation forum, the Conference on Security and Cooperation in Europe (CSCE).

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Dr. Leo Zeffel. Dr. Leo Zeffel spent 38 years with Dupont in research and production. Most of this time was at the Chambers Works, Dupont's largest multiproduct and multipurpose manufacturing site. He was Manager of Material Resources in the Manufacturing Division, Chemicals Department, when he retired from Dupont in 1989. Since 1987 Dr. Zeffel has served on the Chemical Manufacturers Association's Chemical Weapons Work Group, participating in all of the Industry Experts/Treaty Negotiators meetings in Geneva and the Hague, several Pugwash workshops and seminars, and trial inspections at the request of several countries' governmental and non-governmental organizations. He has prepared a number of papers which represent industry viewpoints on verification procedures and protection of Confidential Business Information (CBI). He is currently a consultant to CMA and several other organizations involved in activities related to the Chemical Weapons Treaty.